

## **Eisenmann – Unit 1 follow up Q&A**

### **1. Can you clarify whether the alpha (a) and beta (b) tubulin subunits EACH bind GTP, or and whether the ab dimer binds one or two GTP molecules.**

Good question. The slides may have oversimplified things a little for the sake of time. Each subunit is able to bind to GTP. The  $\alpha$  subunit does not hydrolyze the GTP to GDP, while the  $\beta$  subunit can be either GTP or GDP-bound. Each subunit must be GTP bound to form the  $\alpha\beta$  dimer and to be incorporated into a growing MT, preferably at the + end. Upon incorporation into the + end of the MT, the GTP from the  $\alpha$  subunit is buried and is not hydrolysable, whereas the  $\beta$  subunit GTP is subject to GTP hydrolysis upon the addition of new dimers. Therefore, the net GTP for each incorporated tubulin  $\alpha\beta$  heterodimer within a MT is 1 GTP.

### **2. In terms of protein synthesis and carbohydrate addition to proteins in the Rough ER, what's going on and where? Is anything happening in the lumen of the rough ER? Is the Golgi continuous with the ER?**

Good question. The rough ER working along with the membrane bound ribosomes takes polypeptides and amino acids from the cytosol and advances protein assembly including recognizing targeting sequences. Some of the proteins are delivered into the lumen whilst others are processed within the ER membrane itself. In the lumen some proteins have sugar groups added to them to form glycoproteins. Proteins are folded within the lumen of the rough ER

New data is suggesting that there may be continuity between the ER and Golgi membrane such that materials can pass directly from the ER to Golgi without packaging into vesicles.

### **3. So in peroxisomes, is hydrogen peroxide being manufactured AND decomposed within the organelle?**

Yes. Peroxisomes, can break down amino acids and also can, through oxidative reactions, break down fatty acid chains. Oxidative reactions can produce  $H_2O_2$ , which is highly toxic to cells. Within the peroxisomes are catalases, which as enzymes that break  $H_2O_2$  into its constituents,  $H_2O$  and  $O_2$ , which the cell can handle just fine.

### **4. I know there are lots of differences between apoptosis and necrosis. Are there similarities?**

The final disposition (dead cell) is one similarity. Both pathways produce cell remnants by different means (blebbing and apoptotic bodies vs. cell rupture) and so phagocytosis is required of both processes to clear out cellular remnants. Other than that, they are very different processes.

### **5. I am confused about centrioles vs centrosome. Help!**

Centrosomes are organelles and part of their structure includes things called centrioles. Centrosomes are not membrane bound. The centrioles are little cylindrical pairs in dividing cells, that consist of short stretches of MTs arranged in a 9+2 MT configuration. During mitosis, MTs are organized around the centrioles and form a recognizable spindle pole structure.

Single centrioles mostly exist at the bases of cilia or flagella.

**6. What's the difference between "gated transport" and "transmembrane transport"? They both seemed to be the same thing. What would ligand-gated ion channels be? GLUT transporters? or aquaporins etc?**

Good question. In the lecture, gated transport= nuclear transport (in and out of nucleus to cytosol and vice versa). The “gate” refers to something that can be opened and closed. In this form of transport, the nuclear pore complexes function as selective gates that can actively transport specific macromolecules (>60kDa) and macromolecular assemblies, although they also allow free diffusion of smaller molecules. The topology of the nucleus and cytosol are similar and continuous, due to the nuclear pores- essentially creating a continuous environment. If a large protein is to be imported into the nucleus, for example, it must possess a sorting signal that is recognized by receptor proteins associated with the nuclear pore complex.

In transmembrane transport membrane-bound protein translocators directly transport specific proteins across a membrane from the cytosol into a space that is topologically distinct (think about how lysosomal and peroxisomal environments are kept very distinct and segregated from the cytosol). The transported protein molecule usually must unfold in order to snake through the membrane. The initial transport of selected proteins from the cytosol into the ER lumen or into mitochondria, for example, occurs in this way.

GLUT transporters are one example of a ligand gated ion channel (Plasma Membrane 2 lecture for Block 1 Unit 1 will go into detail on this transporter, as well as other ligand gated ion channels, so I will defer to Dr Smas on this). Aquaporins are transmembrane water transport channels.

**7. What is the resolving power of EM, if light microscopy is .22microns?**

Current technology has EM resolution approaching 1 nanometer or 0.001 microns

**8. I've been so used to seeing cartoons that it makes you think you only have dozens of organelles but the EM image you showed on page 11**

**makes it seem as if we have hundreds of organelles. Correct? How does the cell make sense of this chaotic crowdedness?**

That's a wonderful philosophical question that is best pondered over a bottle (or four) of wine and a table full of friends. Some specialized cells might have hundreds of a particular organelle (for instance phagocytic cells would have 100+ lysosomes, whereas another would only have a hand-full). The spatial and temporal organization and trafficking of things within cells is extraordinary to think about and why science is so bloomin' cool! But do remember, many proteins and such have what essentially boils down to "zip codes" in the form of signal sequences (lock and key idea) that aid in directing and targeting them through the chaos. Other MT tracks, through interaction with specific motor proteins, can also direct the traffic within the cell to deliver cargo to the correct address.

**9. The rough ER is continuous with the nucleus and the SER is continuous with the rough ER. Is the smooth ER continuous with the Golgi apparatus?**

There is no evidence in the literature for this at this time.